APPLICATION FOR UNITED STATES LETTERS PATENT

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TITLE: DEVICE FOR LETTING OFF RESIDUAL STEAM AND WATER FROM THE HEATING UNIT OF A HOT BEVERAGE MACHINE, IN PARTICULAR A COFFEE MACHINE

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CROSS-REFERENCE TO RELATED APPLICATION

0001 This application claims the priority of German Patent Application No. 202 17 068.3 filed November 4, 2002, the subject matter of which is incorporated herein by reference.

BACKGROUND OF THE INVENTION

0002 The invention relates to a device for letting off residual steam and residual water from the heating unit of a coffee machine, as defined in the preamble to claim 1.

0003 With known fluid systems in coffee machines and other hot beverage machines, it is generally desirable to remove any residual water in the heating unit, which remains after the coffee extraction or the hot water release and, once the machine is turned off, is vaporized into steam as a result of existing residual heat or is present in the form of residual water and/or flash water, and is allowed to collect in a collection container that is generally installed inside the coffee machine. The same steps are taken if, following the process of generating steam to supply to a steam nozzle or a frothing nozzle, the heating unit is cooled down with fresh water until it reaches a temperature for preparing coffee. That is to say, unused steam and, if necessary, hot water are also released into the collection container. The steam generated during this operation is also referred to as residual steam or flash steam since its pressure is reduced as compared to the steam generated during the operation, in particular through opening a residual fluid line and shutting down a water pump which otherwise pumps fresh water into the heating unit that is typically designed as flow-through heating unit.

0004 A corresponding device, known from practical operations, for letting off residual steam as defined in the preamble to claim 1 thus comprises a residual fluid line which is connected via an on-off valve to the heating unit, so as to conduct fluids, and which leads to a collection container in the coffee machine. The disadvantage of this device is that some of the residual steam within the coffee machine can escape uncontrolled and can thus affect components inside the coffee machine, particularly the electronic components. These components can be damaged and/or can fail completely and undesirable micro-biological cultures can form even faster. The removal of the residual steam and residual water outside of the housing generally was not planned because of the connected scalding danger.

0005 Thus, it is the object of the present invention to remove the residual steam in a hot-beverage machine, particularly in a coffee machine of the aforementioned type, such that the components inside the hot-beverage machine are not damaged and micro-biological cultures cannot form faster as a result of the supplied moisture.

0006 With the device of the above-defined generic type for removing residual steam and residual water, this object is solved with the features specified in the characterizing section of claim 1.

0007 With this device, the residual steam generated in the heating unit following the release of hot water and/or brewing water and/or steam for the beverage and/or coffee, as well as the residual water generated in the steam-expansion phase in which the on-off valve is opened, is not directly guided via this valve and the residual fluid line into a collection container in the hot-beverage machine, but is guided via a residual fluid line section into

a heat-exchanging and heat-storing capacitor. There, the residual steam is sufficiently cooled down, such that it condenses and runs in a watery phase into the collection container. The heat released in the process by the residual water and the residual steam, in particular the condensation heat, is absorbed by the heat-storing accumulator. During the subsequent feeding of fresh water into the heating unit, the fresh water flows through a fresh-water line section that is inserted into the fresh-water line and is a component of the heat-exchanging and heat-storing capacitor in the same way as the residual fluid line section. As a result, the fresh water pumped through the fresh-water section absorbs heat from the heat-exchanging and heat-storing capacitor and can be heated up to the desired temperature and/or can be vaporized in the heating unit with less energy expenditure In the process, the capacitor is cooled to a temperature that is sufficiently low for condensing the residual steam.

0008 The process has several advantages. The residual steam in the residual fluid line is not supplied in the form of steam to the hot-beverage machine, following the opening of the on-off valve, and an uncontrolled precipitation of moisture is avoided. The safety of the hot-beverage machine is increased. On the other hand, the heat removed from the residual water and the residual steam, in particular through condensation, is used to preheat the fresh water which is subsequently heated further and if necessary is vaporized in the heating unit with a correspondingly reduced amount of energy. In particular, a portion of the extraction heat necessary for preparing coffee can be provided through preheating the fresh water. The required apparatus expenditure basically requires only an additional heat-exchanging and heat-storing capacitor.

0009 A thermal equilibrium between heating-up and cooling-down of the capacitor according to claim 2 is preferably achieved with a sequential control of respectively one fresh-water supply for the heating unit, for which a water pump that is installed in the fresh-water line is switched on and pumps fresh water through the fresh-water line section to the heating unit and further via a pressure-control valve installed in a discharge line of the heating unit which opens with the operating pressure of the water pump, and a respectively following flash-evaporation process where the water pump is shut down and the on-off valve is opened, thus causing residual steam and residual water to flow through this valve from the heating unit through the residual fluid line section. It is furthermore achieved through dimensioning the heat-exchanging and heat-storing capacitor in such a way that during several fresh-water intakes – respectively interrupted by flash evaporation processes - a thermal equilibrium adjusts for the heat-exchanging and heat-storing capacitor during which the residual steam in the residual fluid line section is essentially condensed completely during the flash evaporation process. The capacitor material and mass in this case must be designed such that the condensation effect is maintained during the flash evaporation process, even within the framework of an intensive release of coffee.

The on-off valve as well as the water pump preferably can be synchronized for this.

00010 Instead, it is also possible to control the switching operations so as to be sequential and independent of each other, for example if steam must be generated in the quickest possible way and with the lowest amount of energy, e.g. twice in a row, for the cappuccino preparation. In that case, the steam in the heating unit is not cooled due to

expansion between the two steam-generating operations, but only following the second steam-generating operation.

00011 The components used in the known device for removing residual steam and residual water can for the most part be used to realize the device according to the invention. In connection with the heat-exchanging and heat-storing capacitor, these components can be used so as to optimize the heat exchange with the residual water vaporized into steam in the heating unit and the residual water that remains in the watery phase, as well as the fresh water subsequently supplied to the heating unit.

00012 For this, the residual fluid line can be branched off upstream of the pressure-control valve from the fresh-water intake of the heating unit or its discharge line with the aid of an on-off valve and can thus optimally affect the residual fluid line section of the capacitor, depending on the design and arrangement of the heating unit, meaning during the steam expansion phase when the on-off valve is opened.

00013 A magnetic valve as defined in claim 6 permits an easy timed control.

00014 According to claim 7, the capacitor simply consists of a heat-conducting and heat-storing block of material, in which the residual fluid line section and the fresh-water line section are installed.

00015 With respect to production, it is advantageous if the heat-storing block according to claim 8 is composed of aluminum, with an integrally cast fresh-water line section in the form of a chromium-steel pipe. The chromium-steel pipe prevents a migration of the water through the aluminum.

00016 From a production point of view, it is furthermore advantageous to design the capacitor according to claim 9 with the feature that the block is divided parallel to a plane containing the residual fluid line section, such that the residual fluid line section is exposed in one of the two parts, with the parts of the block being at a distance to each other. The residual fluid line section therefore can simply be formed into the surface of one part of the block.

00017 A compact design of the block is furthermore made possible if the fresh-water line section and the residual fluid line section are arranged one above the other in two parallel planes. A good heat exchange can thus be achieved between the residual fluid line section and the fresh-water line section. For the latter purpose, the residual fluid line section and the fresh water line section according to claim 11 preferably have parallel wavy or meandering line sections in the capacitor block.

00018 The heating unit is preferably designed as flow-through heating unit. The residual water that initially remains in the flow-through heating unit after water is heated and/or steam generated with the water used for the beverage preparation is then vaporized into residual steam by the residual heat remaining in the flow-through heating unit. The residual steam can escape at the fresh-water intake of the flow-through heating unit and can be supplied to the capacitor.

00019 In the following, the invention is explained with the aid of a drawing and two Figures, which can show additional advantageous features and effects. Shown are in:

Figure 1 a schematic total representation of a device for letting off residual steam and residual water from a heating unit inside a coffee machine and

Figure 2 a detail thereof, namely an illustration of a heat-exchanging and heat-storing capacitor.

00020 The reference number 1 in the drawing denotes a fresh-water container that contains cold fresh water. A fresh water line 2 runs from this container via a water pump 3 to a fresh-water intake 4 of a heating unit 5, designed as flow-through heating unit. A discharge line 5a of the heating unit 5 is connected via an excess-pressure valve 6 in the form of a spring-loaded ball valve to a selection switch 7, which leads on the one hand to a brewing head 8 as essential component of a coffee machine, below which a coffee cup 9 is indicated, as well as alternatively to a frothing valve and/or a steam valve 10 which can release steam or hot water. The selection switch 7 settings that must be selected for the coffee or steam generation are shown symbolically in the drawing.

00021 A residual fluid line 11with therein installed on-off valve 12 in the form of a magnetic valve branches off from the fresh-water intake 4, positioned low, for removing residual steam and residual water from the heating unit 5. The residual fluid line 11 leads to a residual fluid line section 13 of a heat-exchanging and heat-storing capacitor 14 while a discharge line 15 on the residual fluid line section 13 empties into a collection container 16, designed as condensate collection container 16, which can be installed inside a coffee machine housing.

00022 A fresh water section 17 that is inserted into the fresh water line 2 essentially completes the capacitor 14.

00023 Figure 2 shows details of the heat-exchanging and heat-storing capacitor 14. The capacitor 14 basically consists of a non-designated block of aluminum that is divided into two parts and contains the meander-shaped residual fluid line section 13 formed in one plane as well as the meander-shaped fresh water section 17 formed in the plane below. In a parallel plane 18, the block is divided into two parts, so that the residual fluid line section 13 can be worked easily from above into the lower part of the block. The upper part of the block on the other hand can be smooth on the underside. The fresh water line section in the form of a chromium-steel pipe and/or stainless steel pipe is incorporated into the lower part of the block. Figure 2 shows that the residual fluid line section 13 and the fresh water line section 17 extend parallel in some sections and have good heat-conducting contact with the surrounding aluminum material of the block, the heat capacity of which is used for the capacitor function.

00024 The pressure-control valve 6 at the output of the heating unit 5 is dimensioned in such a way that it automatically opens the outlet to the fresh water line section 17 if a minimum pressure equaling the water pump 3 operating pressure is exerted onto the valve, which continues through the heating unit 5 designed as flow-through heating unit. The pressure can increase further in this unit as a result of the steam-generating processes. If the water pump 3 is turned off, on the other hand, the pressure-control valve 6 is closed, even if residual steam forms in the flow-through heating unit as a result of residual heat.

00025 Switching contacts that are not shown herein function to operate the water pump 3 and the on-off valve 12 and can be activated such that either the on-off valve 12 is opened or the water pump 3 pumps water to the heating unit 5. For the preparation of coffee or - in another position of the selection switch 7 – of steam and hot water, cold fresh water is pumped through the fresh water line 2 and the fresh water line section 17 into the fresh water intake 4 of the heating unit 5 by the water pump 3, which is turned on depending on the required amount of fresh water. The water is heated up in the heating unit or steam is generated and is released through the opened pressure-control valve 6 as brewing water or into the brewing head 8 or as steam and/or hot water into the frothing valve 10. The on-off valve 12 is closed for this, so that the residual fluid line section 13 of the capacitor 14 is not admitted with the fresh water during the fresh-water intake of the heating unit 5. The water pump 3 is turned off only after the brewing operation and/or the frothing operation is completed and the on-off valve 12 is opened simultaneously. Since the operating pressure of the water pump 3 is removed, the pressure-control valve 6 closes and the residual steam and the residual water forming in the heating unit 5 as a result of the residual heat flow through the residual fluid line 11 and the on-off valve 12 into the residual fluid line section 13 of the capacitor in which the residual steam is cooled down and condensed and where the residual water can also release heat. The condensation water flows through the discharge line 15 into the collection container 16. The heat stored temporarily in the capacitor 14 through the cooling and in particular the condensation of the residual steam can heat up the fresh water pumped through the fresh-water line section 17 during a subsequent restart of the

water pump 3 and closing of the on-off valve 12, wherein the heat-exchanging and heat-storing capacitor 14 simultaneously cools down. The heated fresh water is supplied to the fresh water intake 4 of the heating unit 5. Less energy must therefore be supplied in the heating unit 5 for heating up the fresh water to the desired temperature and/or to the coffee extraction temperature or for generating steam than is the case when cold fresh water is supplied to the heating unit. The device comprising the capacitor 14, the control unit for the water pump 3 and the on-off valve 12 are designed such that a sufficiently low temperature equilibrium adjusts in the capacitor 14 to maintain the condensation effect during the steam expansion processes where residual steam and residual water enter the residual fluid line section 13 even if a large amount of coffee is dispensed.

List of Reference Numbers:

1. fresh water container
2. fresh water line
3. water pump
4. fresh water intake
5. heating unit
5a. discharge line
6. pressure-control valve
7. selection switch
8. brewing head
9. coffee cup
10. frothing nozzle
11. residual fluid line
12. on-off valve
13. residual fluid line section
14. heat-exchanging and heat-conducting capacitor
15. discharge line
16. collection container
17. fresh water line section
18. plane